

## FUNCTIONAL MATERIALS FOR USE IN OPTICAL SYSTEMS

### CLAIMS

We claim:

- 1 1. A functional optical material for use in an optical system, comprising:
  - 2 (a) a polymer selected from the group comprising,
    - 3 (1) a thermoplastic polymer;
    - 4 (2) a thermosetting polymer; and
    - 5 (3) a combination of thermoplastic and thermosetting polymers;
  - 6 wherein said thermoplastic and/or thermosetting polymers contain
  - 7 carbon-hydrogen and/or carbon-fluoride functionality; and
  - 8 (b) one or more optically active chromophores blended and/or copolymerized
  - 9 with said polymer;
  - 10 (c) a compatibilizer copolymerized with said polymer of step (a), having one
  - 11 or more pendant groups selected from the group consisting of nitriles, esters,
  - 12 aromatics; fluorinated esters, and fluorinated aromatics; and
  - 13 (d) an adhesion promoter copolymerized with said polymer of step (a), having
  - 14 one or more pendant groups selected from the group consisting of nitriles,
  - 15 silanes, fluorinated silanes, organic acids; fluorinated organic acids, alcohols,
  - 16 fluorinated alcohols, amides, and amines; and
  - 17 wherein when a compatibilizer with one particular pendant group is selected,
  - 18 an adhesion promoter with a different pendant group is selected.
- 1 2. The functional optical material according to Claim 1, wherein said
  - 2 thermoplastic and/or thermosetting polymer is selected from the group
  - 3 consisting of acrylics /methacrylics; copolymers of acrylic acid esters,
  - 4 methacrylic acid esters, and other single unsaturated monomers; polyesters;
  - 5 polyurethanes; polyimides; polyamides; polyphosphazenes; epoxy resin; and
  - 6 hybrid (organic-inorganic) or nanocomposite polyester polymers.

1 3. The functional optical material according to Claim 1, wherein said  
2 thermoplastic polymer is selected from the group consisting of  
3 acrylics/methacrylics (copolymers of esters of acrylic and methacrylic acid  
4 where the alcohol portion of the ester can be based on hydrocarbon, or  
5 partially or fully fluorinated alkyl chains); polyesters (where the diacid or diol  
6 can contain carbon-hydrogen aliphatic, aromatic or carbon-fluorine  
7 functionality); polyurethanes (where the diisocyanate can be aliphatic or  
8 aromatic and the diol can contain carbon-hydrogen or carbon-fluorine  
9 functionality); polyimides where the acid, amine, or diamine can be partially  
10 or fully fluorinated; polyamides (where the diacid or diamine can contain  
11 carbon – hydrogen aliphatic, aromatic or carbon-fluorine functionality);  
12 polyphosphazenes (where the polyphosphazene backbone structure can  
13 contain fluorinated aromatic or aliphatic functional groups, as well as, carbon-  
14 hydrogen functionality); epoxy resin (where the epoxy resin can contain  
15 carbon-hydrogen or carbon-fluorine functionality<sup>0</sup> which can further be  
16 reacted with diacids or anhydrides (that also contain carbon-hydrogen or  
17 carbon-fluorine functionality); and hybrid (organic-inorganic) or  
18 nanocomposite polyester polymers (where the polyester component consists  
19 of aliphatic, aromatic carbon hydrogen or carbon-fluorine functionality and the  
20 inorganic components are based on silane or organometallic materials such as  
21 titanates, zirconates and other multivalent metal organics).

1 4. The functional optical material according to Claim 1, wherein functional  
2 optical material has a glass transition temperature above 100°C.

1 5. The functional optical material according to Claim 1, wherein said  
2 functional optical material has a refractive index value of less than about 1.5.

1 6. The functional optical material according to Claim 1, wherein said  
2 functional optical material has a refractive index value of greater than or  
3 equal to about 1.5.

- 1 7. The functional optical material according to Claim 1, wherein said  
2 functional optical material has between 0.1 and 10% of a promoter having an  
3 adhesive promotion group, or combination of adhesive promotion groups.
- 1 8. The functional optical material according to Claim 1, wherein said  
2 compatibilizer has nitrile, ester, fluorinated ester, and fluorinated aromatic  
3 groups.
- 1 9. The functional optical material according to Claim 1, wherein said  
2 adhesion promoter has nitrile, silane, fluorinated silane, organic acid;  
3 fluorinated organic acid, alcohol, and fluorinated alcohol groups.
- 1 10. The functional optical material according to Claim 1, wherein  
2 monomers are included that provide water resistance by having styrene  
3 and/or cycloaliphatic groups.
- 1 11. The functional optical material according to Claim 1, wherein said  
2 functional optical material has between 0.1 and 20% of one or more  
3 compatibilizers for said one or more chromophores.
- 1 12. The functional optical material according to Claim 1, wherein there is  
2 less than 5 wt.% of hydrogen in the monomer repeat unit and other units of  
3 the functional optical material).
- 1 13. The functional optical material according to Claim 1, wherein said  
2 functional optical material has less than 2% water absorption according to a  
3 24 hour water immersion test.
- 1 14. The functional optical material according to Claim 1, wherein said  
2 functional optical material requires less than 100 volts per micron of film  
3 thickness to pole said functional optical material.

1 15. The functional material according to Claim 1, wherein a compatibilizer  
2 is selected having a nitrile group, and an adhesion promoter is selected  
3 having a silane group.

1 16. The functional optical material according to Claim 1, wherein said one  
2 or more optically active chromophores is (are) selected from the group  
3 consisting of a substituted aniline, substituted azobenzene, substituted  
4 stilbene, or substituted imine.

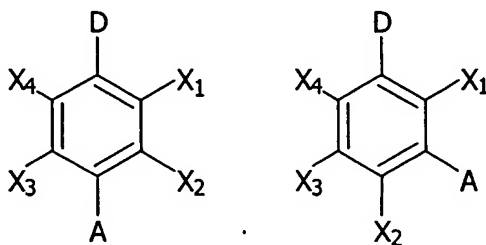
1 17. The functional optical material according to Claim 16, wherein said one  
2 or more optically active chromophores are selected from substituted anilines  
3 comprising:

4 first substituted anilines,

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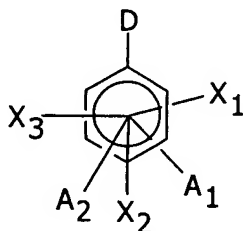
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10 Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
11 alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane  
12 derivatives;

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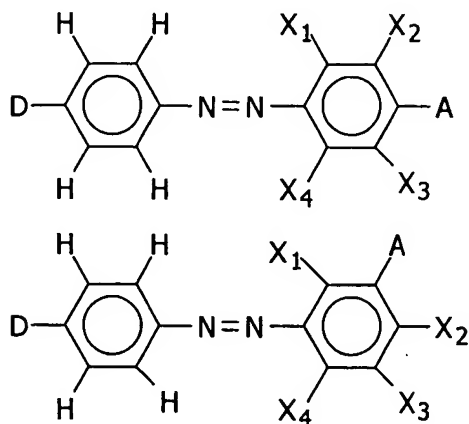
14 A = acceptor =  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , or  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,  
15  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$

16 wherein when  $A = -NO_2$ , or  $-C(CN)C(CN)_2$ , then  $X_1, X_2, X_3, X_4$  are each  
 17 independently selected from the group -F and -H, and at least one -F is  
 18 selected, and when  $A = -N=C(R_1)(R_2)$ , wherein  $R_1 = CF_3, C_2F_5, C_nF_{2n+1}$ ,  $R_2 =$   
 19 H,  $CH_3, CF_3, C_2F_5$ , then  $X_1, X_2, X_3, X_4$  are each independently selected from  
 20 the group -F and -H;  
 21  
 22 or second substituted anilines,



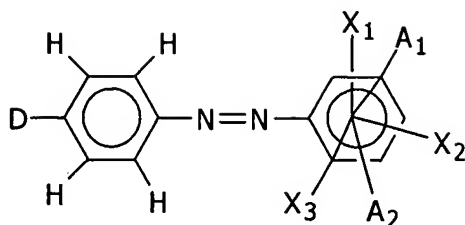
23  
 24 Wherein  $D = \text{donor} = -NH_2, -N(CH_3)_2, -N(CH_2CH_3)_2$ , or  $-N(Y)_2$  where  $Y =$   
 25 alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane  
 26 derivatives;  
 27  
 28  $A_1 = \text{primary acceptor} = -NO_2, -C(CN)C(CN)_2$ , or  $-N=C(R_1)(R_2)$ , where  
 29  $R_1 = CF_3, C_2F_5, C_nF_{2n+1}$ ,  $R_2 = H, CH_3, CF_3, C_2F_5$   
 30  
 31  $A_2 = \text{secondary acceptor} = -CN$ , or  $-CF_3$   
 32  
 33 wherein  $X_1, X_2, X_3$  are each independently selected from the group -F and -H;  
 34  
 35 and wherein  $A_1$  can be the same as  $A_2$ , wherein two identical or different  
 36 acceptors may be selected from group  $A_1$  or two identical or different  
 37 acceptors may be selected from group  $A_2$ , so that when acceptors are  
 38 selected from  $-NO_2, -C(CN)C(CN)_2, -CN$ , or  $-CF_3$ , then  $X_1, X_2, X_3$  are each  
 39 independently selected from the group -F and -H, and at least one -F is  
 40 selected; and if at least one acceptor is selected as  $-N=C(R_1)(R_2)$ , where  
 41  $R_1 = CF_3, C_2F_5, C_nF_{2n+1}$ ,  $R_2 = H, CH_3, CF_3, C_2F_5$ , then  $X_1, X_2, X_3$  are each  
 42 independently selected from the group -F and -H.

1 18. The functional optical material according to Claim 16, wherein said one  
 2 or more optically active chromophores is (are) selected from substituted  
 3 azobenzenes comprising:  
 4 first substituted azobenzenes,



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 6  
 7 Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
 8 alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane  
 9 derivatives;  
 10  
 11 A = acceptor =  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , or  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,  
 12  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$   
 13 wherein when A =  $-\text{NO}_2$ , or  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each  
 14 independently selected from the group -F and -H, and at least one -F is  
 15 selected, and when A =  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 =$   
 16  $\text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each independently selected from  
 17 the group -F and -H;  
 18  
 19 or second substituted azobenzenes,

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24   Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
 25   alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane  
 26   derivatives;

27

28   primary acceptor =  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , or  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , where  $\text{R}_1 =$   
 29    $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$

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31   secondary acceptor =  $-\text{CN}$ , or  $-\text{CF}_3$

32

33   wherein if  $\text{A}_1$  and  $\text{A}_2$  are both primary acceptors selected from  $-\text{NO}_2$ , or  
 34    $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from -F and -  
 35   H, but at least one -F must be selected;

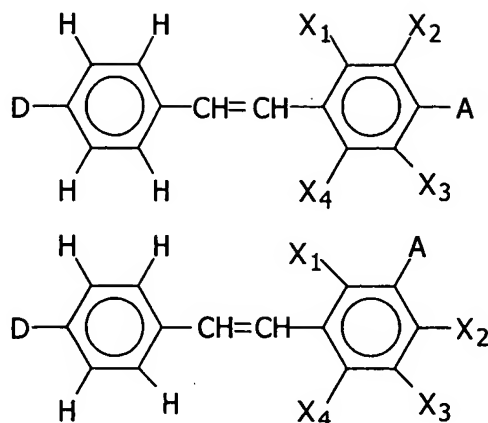
36   wherein if  $\text{A}_1$  and  $\text{A}_2$  are both secondary acceptors selected from  $-\text{NO}_2$ , or  
 37    $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from -F and -  
 38   H, but at least one -F must be selected;

39   wherein if  $\text{A}_1$  and/or  $\text{A}_2$  are selected from the primary acceptor  $-\text{N}=\text{C}$   
 40    $(\text{R}_1)(\text{R}_2)$ , where  $\text{R}_1 = \text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$   
 41   are each independently selected from -F and -H; and

42   wherein if  $\text{A}_1$  is selected from any primary acceptor, and  $\text{A}_2$  is selected from  
 43   any secondary acceptor, then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from  
 44   -F and -H.

1   19.   The functional optical material according to Claim 16, wherein said one  
 2   or more optically active chromophores is (are) selected from substituted  
 3   stilbenes comprising:

4 first substituted stilbenes,



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7 Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
8 alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane  
9 derivatives;

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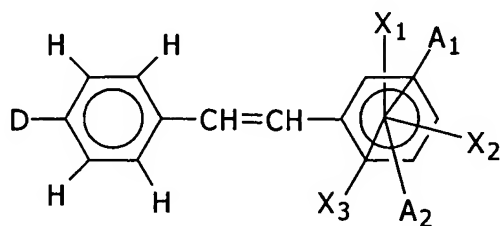
11 A = acceptor =  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , or  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,  
12  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$

13 wherein when A =  $-\text{NO}_2$ , or  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each  
14 independently selected from the group -F and -H, and at least one -F is  
15 selected, and when A =  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 =$   
16  $\text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each independently selected from  
17 the group -F and -H;

18

19 or second substituted stilbenes,

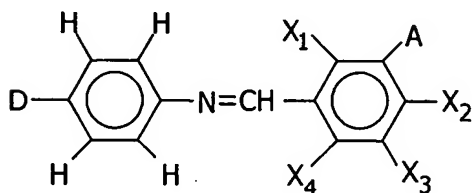
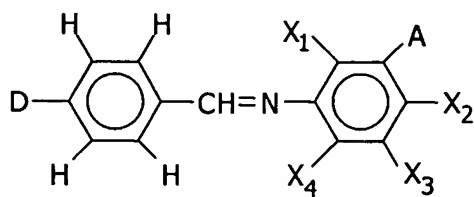
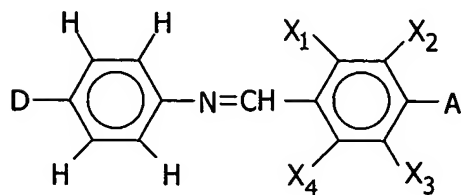
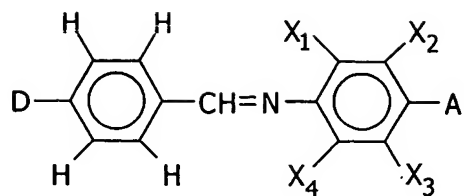
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21   Wherein D = donor =  $\text{—NH}_2$ ,  $\text{—N(CH}_3)_2$ ,  $\text{—N(CH}_2\text{CH}_3)_2$ , or  $\text{—N(Y)}_2$  where Y =  
 22   alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane  
 23   derivatives;  
 24  
 25   primary acceptor =  $\text{—NO}_2$ ,  $\text{—C(CN)C(CN)}_2$ , or  $\text{—N=C (R}_1\text{)(R}_2\text{)}$ , where  $\text{R}_1$ =  
 26    $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2$  = H,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$   
 27  
 28   secondary acceptor =  $\text{—CN}$ , or  $\text{—CF}_3$   
 29  
 30   wherein if  $\text{A}_1$  and  $\text{A}_2$  are both primary acceptors selected from  $\text{—NO}_2$ , or  
 31    $\text{—C(CN)C(CN)}_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from -F and -  
 32   H, but at least one -F must be selected;  
 33   wherein if  $\text{A}_1$  and  $\text{A}_2$  are both secondary acceptors selected from  $\text{—NO}_2$ , or  
 34    $\text{—C(CN)C(CN)}_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from -F and -  
 35   H, but at least one -F must be selected;  
 36   wherein if  $\text{A}_1$  and/or  $\text{A}_2$  are selected from the primary acceptor  $\text{—N=C}$   
 37    $\text{(R}_1\text{)(R}_2\text{)}$ , where  $\text{R}_1$ =  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2$  = H,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$   
 38   are each independently selected from -F and -H; and  
 39   wherein if  $\text{A}_1$  is selected from any primary acceptor, and  $\text{A}_2$  is selected from  
 40   any secondary acceptor, then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from  
 41   -F and -H.

1   20.   The functional optical material according to Claim 16, wherein said one  
 2   or more optically active chromophores is (are) selected from substituted  
 3   imines comprising:  
 4   first substituted imines,  
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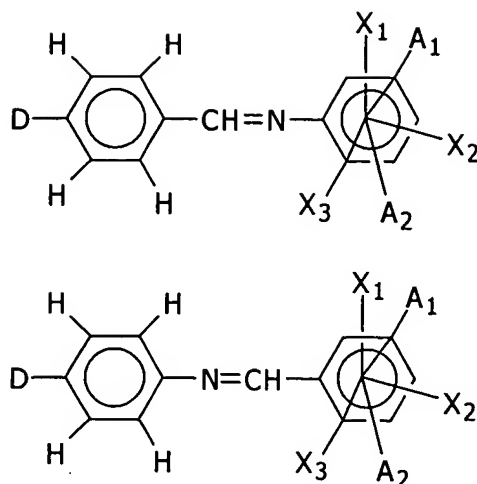
8   Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
9   alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane  
10   derivatives;

11

12   A = acceptor =  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , or  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,  
13    $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$   
14   wherein when A =  $-\text{NO}_2$ , or  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each  
15   independently selected from the group -F and -H, and at least one -F is  
16   selected, and when A =  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 =$   
17   H,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each independently selected from  
18   the group -F and -H;

19

20   or second substituted imines,



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24 Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
 25 alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane  
 26 derivatives;

27

28 primary acceptor =  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , or  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , where  $\text{R}_1 =$   
 29  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$

30

31 secondary acceptor =  $-\text{CN}$ , or  $-\text{CF}_3$

32

33 wherein if  $A_1$  and  $A_2$  are both primary acceptors selected from  $-\text{NO}_2$ , or  
 34  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $X_1$ ,  $X_2$ ,  $X_3$  are each independently selected from -F and -  
 35 H, but at least one -F must be selected;

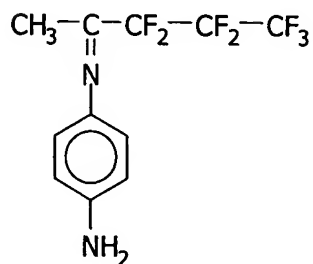
36 wherein if  $A_1$  and  $A_2$  are both secondary acceptors selected from  $-\text{NO}_2$ , or  
 37  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $X_1$ ,  $X_2$ ,  $X_3$  are each independently selected from -F and -  
 38 H, but at least one -F must be selected;

39 wherein if  $A_1$  and/or  $A_2$  are selected from the primary acceptor  $-\text{N}=\text{C}$   
 40  $(\text{R}_1)(\text{R}_2)$ , where  $\text{R}_1 = \text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ , then  $X_1$ ,  $X_2$ ,  $X_3$   
 41 are each independently selected from -F and -H; and

42 wherein if A<sub>1</sub> is selected from any primary acceptor, and A<sub>2</sub> is selected from  
43 any secondary acceptor, then X<sub>1</sub>, X<sub>2</sub>, X<sub>3</sub> are each independently selected from  
44 -F and -H.

1 21. The functional optical material according to Claim 16, wherein one of  
2 said optically active chromophores comprises:

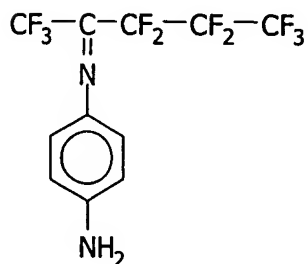
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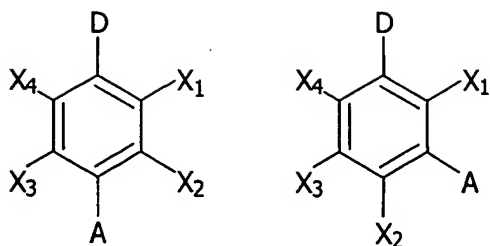
1 22. The functional optical material according to Claim 16, wherein one of  
2 said optically active chromophores comprises:

3



4

1 23. The functional optical material according to Claim 16, wherein said  
2 compatibilizer has a nitrile group, and said one or more optically active  
3 chromophores are selected from conventional substituted anilines comprising:



4

5   Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
6   alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane  
7   derivatives;

8

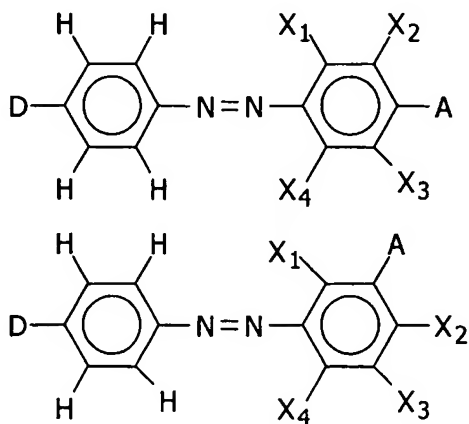
9   A = acceptor =  $-\text{NO}_2$ , or  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , and

10

11   wherein  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each -H.

1   24.   The functional optical material according to Claim 16, wherein said one  
2   or more optically active chromophores is (are) selected from conventional  
3   substituted azobenzenes comprising:

4

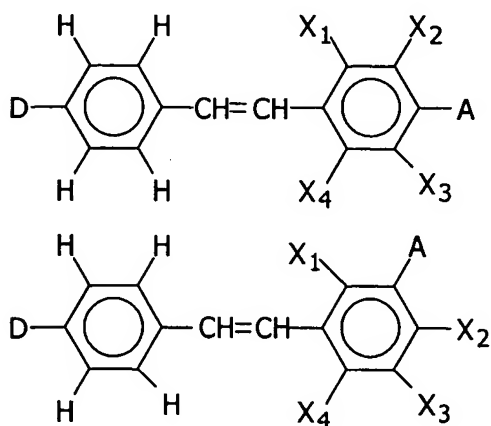


5

6   Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
7   alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane  
8   derivatives;

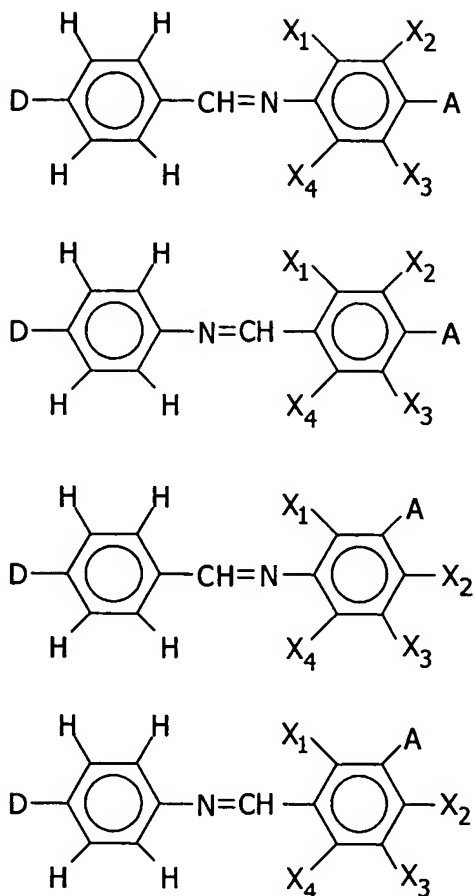
9  
 10 A = acceptor =  $-\text{NO}_2$ , or  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , and  
 11  
 12 wherein  $\text{X}_1, \text{X}_2, \text{X}_3, \text{X}_4$  are each -H.

1 25. The functional optical material according to Claim 16, wherein said one  
 2 or more optically active chromophores is (are) selected from conventional  
 3 substituted stilbenes comprising:  
 4



5  
 6 Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
 7 alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane  
 8 derivatives;  
 9  
 10 A = acceptor =  $-\text{NO}_2$ , or  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , and  
 11  
 12 wherein  $\text{X}_1, \text{X}_2, \text{X}_3, \text{X}_4$  are each -H.

1 26. The functional optical material according to Claim 16, wherein said one  
 2 or more optically active chromophores is (are) selected from conventional  
 3 substituted imines comprising:  
 4



5

6

7 Wherein  $\text{D}$  = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where  $\text{Y}$  =  
 8 alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane  
 9 derivatives;

10

11  $\text{A}$  = acceptor =  $-\text{NO}_2$ , or  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , and

12

13 wherein  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each  $-\text{H}$ .

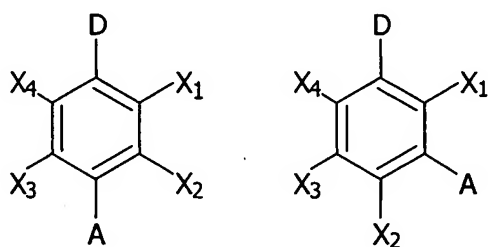
1 27. A functional optical material for use in an optical system, comprising:

2 (a) a polymer selected from the group comprising,

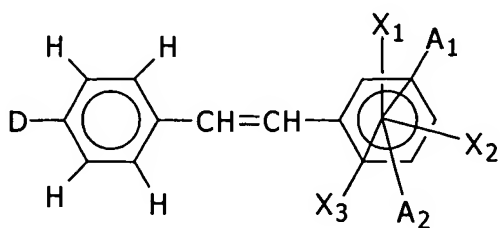
3 (1) a thermoplastic polymer;

4 (2) a thermosetting polymer; and

5 (3) a combination of thermoplastic and thermosetting polymers;  
 6 wherein said thermoplastic and/or thermosetting polymers contain  
 7 carbon-hydrogen and/or carbon-fluoride functionality; and  
 8 (b) one or more optically active chromophores blended and/or copolymerized  
 9 with said polymer, wherein said chromophore comprises:  
 10 first substituted anilines



11  
 12 Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
 13 alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane  
 14 derivatives;  
 15  
 16 A = acceptor =  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , or  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,  
 17  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$   
 18 wherein when A =  $-\text{NO}_2$ , or  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each  
 19 independently selected from the group -F and -H, and at least one -F is  
 20 selected, and when A =  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 =$   
 21  $\text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each independently selected from  
 22 the group -F and -H;  
 23  
 24 or second substituted anilines,



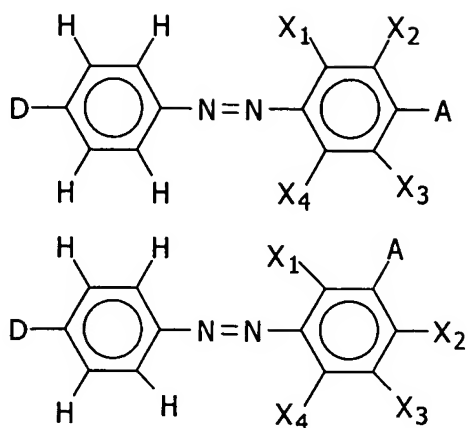
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27   Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
 28   alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane  
 29   derivatives;  
 30  
 31    $\text{A}_1$  = primary acceptor =  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , or  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , where  
 32    $\text{R}_1 = \text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$   
 33  
 34    $\text{A}_2$  = secondary acceptor =  $-\text{CN}$ , or  $-\text{CF}_3$   
 35  
 36   wherein  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from the group -F and -H;  
 37  
 38   and wherein  $\text{A}_1$  can be the same as  $\text{A}_2$ , wherein two identical or different  
 39   acceptors may be selected from group  $\text{A}_1$  or two identical or different  
 40   acceptors may be selected from group  $\text{A}_2$ , so that when acceptors are  
 41   selected from  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ ,  $-\text{CN}$ , or  $-\text{CF}_3$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each  
 42   independently selected from the group -F and -H, and at least one -F is  
 43   selected; and if at least one acceptor is selected as  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , where  
 44    $\text{R}_1 = \text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each  
 45   independently selected from the group -F and -H.

- 1   28.   A functional optical material for use in an optical system, comprising:  
 2   (a) a polymer selected from the group comprising,  
 3       (1) a thermoplastic polymer;  
 4       (2) a thermosetting polymer; and  
 5       (3) a combination of thermoplastic and thermosetting polymers;  
 6       wherein said thermoplastic and/or thermosetting polymers contain  
 7       carbon-hydrogen and/or carbon-fluoride functionality; and  
 8   (b) one or more optically active chromophores blended and/or copolymerized  
 9   with said polymer, wherein said chromophore comprises:

10 first substituted azobenzenes



11

12 Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
 13 alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane  
 14 derivatives;

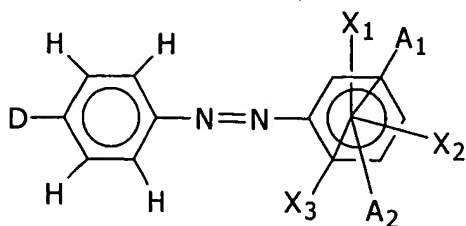
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16 A = acceptor =  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , or  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,  
 17  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$   
 18 wherein when A =  $-\text{NO}_2$ , or  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each  
 19 independently selected from the group -F and -H, and at least one -F is  
 20 selected, and when A =  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 =$   
 21  $\text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each independently selected from  
 22 the group -F and -H;

23

24 or second substituted azobenzenes,

25

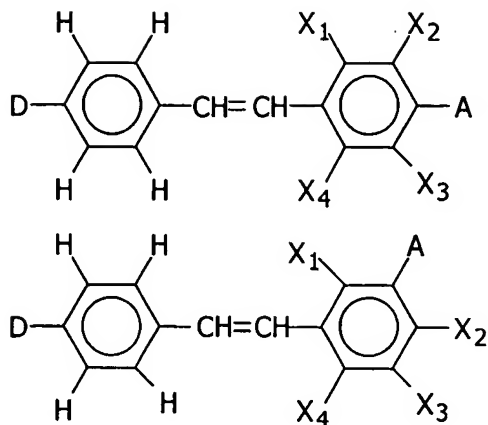


26

27   Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
 28   alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane  
 29   derivatives;  
 30  
 31   primary acceptor =  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , or  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , where  $\text{R}_1 =$   
 32    $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$   
 33  
 34   secondary acceptor =  $-\text{CN}$ , or  $-\text{CF}_3$   
 35  
 36   wherein if  $\text{A}_1$  and  $\text{A}_2$  are both primary acceptors selected from  $-\text{NO}_2$ , or  
 37    $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from  $-\text{F}$  and  $-\text{H}$ ,  
 38   but at least one  $-\text{F}$  must be selected;  
 39   wherein if  $\text{A}_1$  and  $\text{A}_2$  are both secondary acceptors selected from  $-\text{NO}_2$ , or  
 40    $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from  $-\text{F}$  and  $-\text{H}$ ,  
 41   but at least one  $-\text{F}$  must be selected;  
 42   wherein if  $\text{A}_1$  and/or  $\text{A}_2$  are selected from the primary acceptor  $-\text{N}=\text{C}$   
 43    $(\text{R}_1)(\text{R}_2)$ , where  $\text{R}_1 = \text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$   
 44   are each independently selected from  $-\text{F}$  and  $-\text{H}$ ; and  
 45   wherein if  $\text{A}_1$  is selected from any primary acceptor, and  $\text{A}_2$  is selected from  
 46   any secondary acceptor, then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from  
 47    $-\text{F}$  and  $-\text{H}$ .

1   29.   A functional optical material for use in an optical system, comprising:  
 2   (a) a polymer selected from the group comprising,  
 3       (1) a thermoplastic polymer;  
 4       (2) a thermosetting polymer; and  
 5       (3) a combination of thermoplastic and thermosetting polymers;  
 6       wherein said thermoplastic and/or thermosetting polymers contain  
 7       carbon-hydrogen and/or carbon-fluoride functionality; and  
 8   (b) one or more optically active chromophores blended and/or copolymerized  
 9   with said polymer, wherein said chromophore comprises:  
 10   first substituted stilbenes

11



12

13

14 Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
 15 alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane  
 16 derivatives;

17

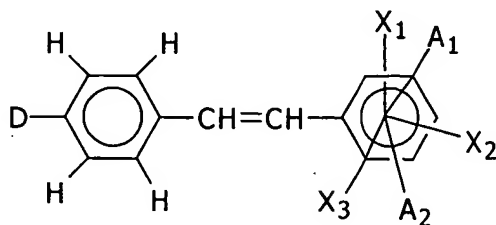
18 A = acceptor =  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , or  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,  
 19  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$

20 wherein when A =  $-\text{NO}_2$ , or  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each  
 21 independently selected from the group -F and -H, and at least one -F is  
 22 selected, and when A =  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 =$   
 23  $\text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each independently selected from  
 24 the group -F and -H;

25

26 or second substituted stilbenes,

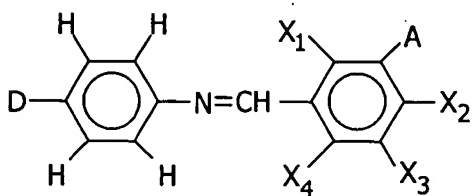
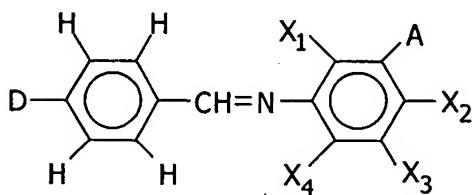
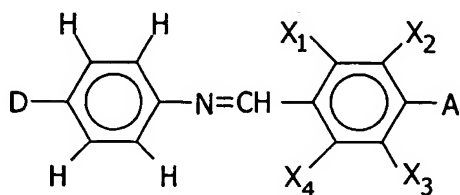
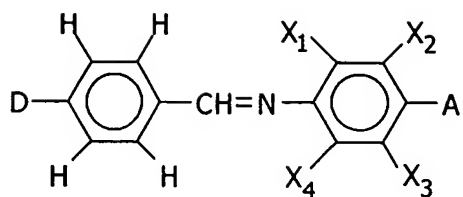
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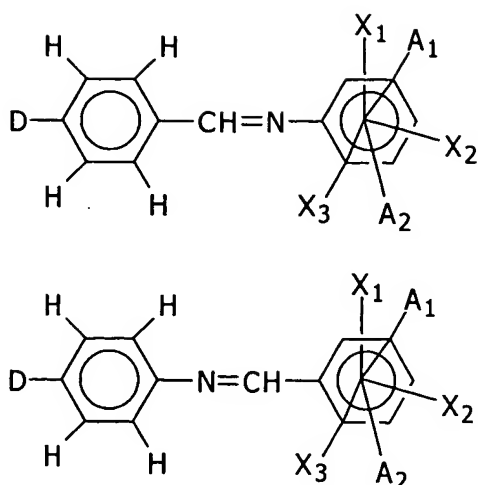
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29   Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =  
 30   alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane  
 31   derivatives;  
 32  
 33   primary acceptor =  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , or  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , where  $\text{R}_1 =$   
 34    $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$   
 35  
 36   secondary acceptor =  $-\text{CN}$ , or  $-\text{CF}_3$   
 37  
 38   wherein if  $\text{A}_1$  and  $\text{A}_2$  are both primary acceptors selected from  $-\text{NO}_2$ , or  
 39    $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from  $-\text{F}$  and  $-\text{H}$ ,  
 40   but at least one  $-\text{F}$  must be selected;  
 41   wherein if  $\text{A}_1$  and  $\text{A}_2$  are both secondary acceptors selected from  $-\text{NO}_2$ , or  
 42    $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from  $-\text{F}$  and  $-\text{H}$ ,  
 43   but at least one  $-\text{F}$  must be selected;  
 44   wherein if  $\text{A}_1$  and/or  $\text{A}_2$  are selected from the primary acceptor  $-\text{N}=\text{C}$   
 45    $(\text{R}_1)(\text{R}_2)$ , where  $\text{R}_1 = \text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$   
 46   are each independently selected from  $-\text{F}$  and  $-\text{H}$ ; and  
 47   wherein if  $\text{A}_1$  is selected from any primary acceptor, and  $\text{A}_2$  is selected from  
 48   any secondary acceptor, then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from  
 49    $-\text{F}$  and  $-\text{H}$ .

1   30.   A functional optical material for use in an optical system, comprising:  
 2   (a) a polymer selected from the group comprising,  
 3       (1) a thermoplastic polymer;  
 4       (2) a thermosetting polymer; and  
 5       (3) a combination of thermoplastic and thermosetting polymers;  
 6       wherein said thermoplastic and/or thermosetting polymers contain  
 7       carbon-hydrogen and/or carbon-fluoride functionality; and  
 8   (b) one or more optically active chromophores blended and/or copolymerized  
 9   with said polymer, wherein said chromophore comprises:  
 10   first substituted imines,

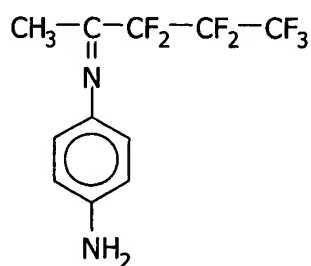


- 11
- 12   Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =
- 13   alkyl alcohols, alkyl (hydrocarbon fluorocarbon) esters, or alkyl silane
- 14   derivatives;
- 15
- 16   A = acceptor =  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , or  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,
- 17    $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$
- 18   wherein when A =  $-\text{NO}_2$ , or  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each
- 19   independently selected from the group -F and -H, and at least one -F is
- 20   selected, and when A =  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , wherein  $\text{R}_1 = \text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 =$
- 21    $\text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$ ,  $\text{X}_4$  are each independently selected from
- 22   the group -F and -H;
- 23
- 24   or second substituted imines,
- 25

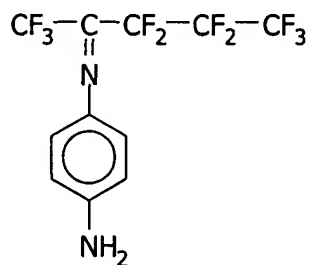


- 26
- 27   Wherein D = donor =  $-\text{NH}_2$ ,  $-\text{N}(\text{CH}_3)_2$ ,  $-\text{N}(\text{CH}_2\text{CH}_3)_2$ , or  $-\text{N}(\text{Y})_2$  where Y =
- 28   alkyl alcohols, alkyl (hydrocarbon or fluorocarbon) esters, or alkyl silane
- 29   derivatives;
- 30
- 31   primary acceptor =  $-\text{NO}_2$ ,  $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , or  $-\text{N}=\text{C}(\text{R}_1)(\text{R}_2)$ , where  $\text{R}_1=$
- 32    $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$
- 33
- 34   secondary acceptor =  $-\text{CN}$ , or  $-\text{CF}_3$
- 35
- 36   wherein if  $\text{A}_1$  and  $\text{A}_2$  are both primary acceptors selected from  $-\text{NO}_2$ , or
- 37    $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from  $-\text{F}$  and  $-\text{H}$ , but at least one  $-\text{F}$  must be selected;
- 38
- 39   wherein if  $\text{A}_1$  and  $\text{A}_2$  are both secondary acceptors selected from  $-\text{NO}_2$ , or
- 40    $-\text{C}(\text{CN})\text{C}(\text{CN})_2$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from  $-\text{F}$  and  $-\text{H}$ , but at least one  $-\text{F}$  must be selected;
- 41
- 42   wherein if  $\text{A}_1$  and/or  $\text{A}_2$  are selected from the primary acceptor  $-\text{N}=\text{C}$
- 43    $(\text{R}_1)(\text{R}_2)$ , where  $\text{R}_1= \text{CF}_3$ ,  $\text{C}_2\text{F}_5$ ,  $\text{C}_n\text{F}_{2n+1}$ ,  $\text{R}_2 = \text{H}$ ,  $\text{CH}_3$ ,  $\text{CF}_3$ ,  $\text{C}_2\text{F}_5$ , then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$
- 44   are each independently selected from  $-\text{F}$  and  $-\text{H}$ ; and
- 45   wherein if  $\text{A}_1$  is selected from any primary acceptor, and  $\text{A}_2$  is selected from
- 46   any secondary acceptor, then  $\text{X}_1$ ,  $\text{X}_2$ ,  $\text{X}_3$  are each independently selected from
- 47    $-\text{F}$  and  $-\text{H}$ .

- 1 31. A functional optical material for use in an optical system, comprising:
- 2 (a) a polymer selected from the group comprising,
- 3 (1) a thermoplastic polymer;
- 4 (2) a thermosetting polymer; and
- 5 (3) a combination of thermoplastic and thermosetting polymers;
- 6 wherein said thermoplastic and/or thermosetting polymers contain
- 7 carbon-hydrogen and/or carbon-fluoride functionality; and
- 8 (b) one or more optically active chromophores blended and/or copolymerized
- 9 with said polymer, wherein at least one chromophore comprises:



- 1 32. A functional optical material for use in an optical system, comprising:
- 2 (a) a polymer selected from the group comprising,
- 3 (1) a thermoplastic polymer;
- 4 (2) a thermosetting polymer; and
- 5 (3) a combination of thermoplastic and thermosetting polymers;
- 6 wherein said thermoplastic and/or thermosetting polymers contain
- 7 carbon-hydrogen and/or carbon-fluoride functionality; and
- 8 (b) one or more optically active chromophores blended and/or copolymerized
- 9 with said polymer, wherein at least one chromophore comprises:





1 33. A functional optical material useful in an optical system comprising: a  
2 polymer of  
3 (a) one or more partially or fully fluorinated first monomer(s) having a  
4 refractive index of less than about 1.5, or wherein a homopolymer formed  
5 from said first monomer(s) has a refractive index of less than about 1.5;  
6 (b) zero, one, or more second monomer(s) having a refractive index  $\geq 1.5$ , or  
7 wherein a homopolymer formed from said second monomer(s) has a  
8 refractive index  $\geq 1.5$ ;  
9 (c) at least one optically active chromophore;  
10 (d) at least one compatibilizer for said optically active chromophore;  
11 (e) at least one adhesion promoter, having one or more pendant groups  
12 selected from the group consisting of nitriles, silanes, fluorinated silanes,  
13 organic acids; fluorinated organic acids, alcohols, fluorinated alcohols, amides,  
14 and amines; wherein when a compatibilizer with one particular pendant group  
15 is selected, an adhesion promoter with a different pendant group is selected.

1 34. A method of forming a functional optical material comprising:  
2 A. determining if a low index of refraction material ( $n < 1.5$ ) or high index of  
3 refraction material ( $n \geq 1.5$ ) is desired,  
4 B. for a low refractive index optical material  
5 (1) selecting one or more monomers having a low index of refraction;  
6 (2) selecting zero, one, or more monomers having a high index of  
7 refraction, wherein the concentration of the monomer(s) with a high  
8 index of refraction is less than the concentration of monomer(s) having  
9 a low index of refraction;  
10 (3) selecting zero, one or more optically active chromophores;  
11 (4) selecting zero, one, or more of conventional optical chromophores ,  
12 with the proviso that at least one chromophore must be selected;  
13 (5) selecting one or more compatibilizers for the selected  
14 chromophore(s), having one or more pendant groups selected from the  
15 group consisting of nitriles, esters, aromatics; fluorinated esters, and  
16 fluorinated aromatics; and

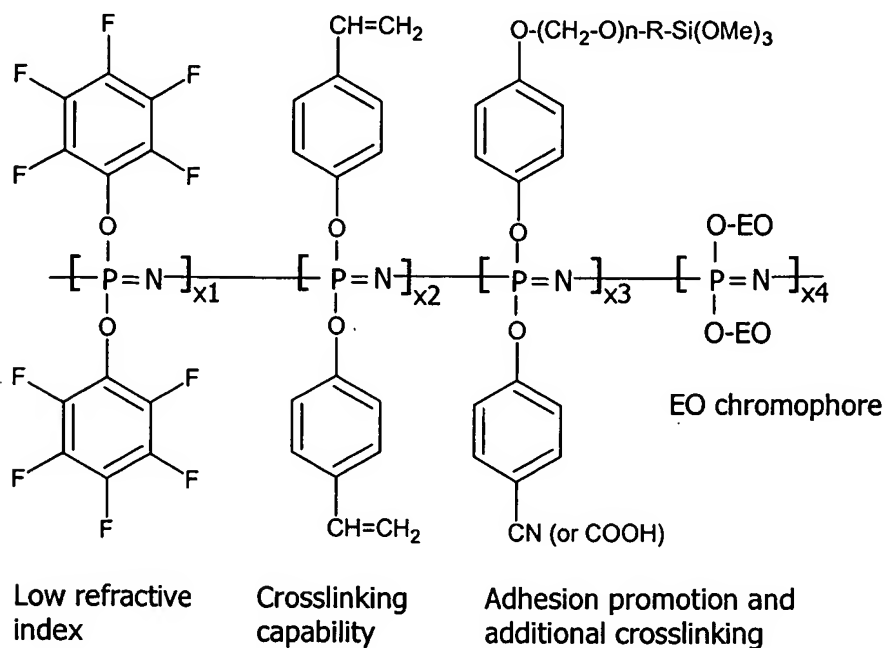
17 (6) selecting one or more adhesion enhancers, having one or more  
18 pendant groups selected from the group consisting of nitriles, silanes,  
19 fluorinated silanes, organic acids; fluorinated organic acids, alcohols,  
20 fluorinated alcohols, amides, and amines; wherein when a  
21 compatibilizer with one particular pendant group is selected, an  
22 adhesion promoter with a different pendant group is selected; and  
23 (7) mixing and reacting said selected monomer(s), chromophore(s),  
24 compatibilizer, and adhesion enhancer.

25 C. for a high refractive index optical material

26 (1) selecting one or more monomers having a high index of refraction;  
27 (2) selecting zero, one, or more monomers having a low index of  
28 refraction, wherein the concentration of the monomer(s) with a low  
29 index of refraction is less than the concentration of monomer(s) having  
30 a high index of refraction;  
31 (3) selecting zero, one or more optically active chromophores;  
32 (4) selecting zero, one, or more of conventional optical chromophores ,  
33 with the proviso that at least one chromophore must be selected;  
34 (5) selecting one or more compatibilizers for the selected  
35 chromophore(s), having one or more pendant groups selected from the  
36 group consisting of nitriles, esters, aromatics; fluorinated esters, and  
37 fluorinated aromatics; and  
38 (6) selecting one or more adhesion enhancers, having one or more  
39 pendant groups selected from the group consisting of nitriles, silanes,  
40 fluorinated silanes, organic acids ????; fluorinated organic acids,  
41 alcohols, fluorinated alcohols, amides, and amines; wherein when a  
42 compatibilizer with one particular pendant group is selected, an  
43 adhesion promoter with a different pendant group is selected; and  
44 (7) mixing and reacting said selected monomer(s), chromophore(s),  
45 compatibilizer, and adhesion enhancer.

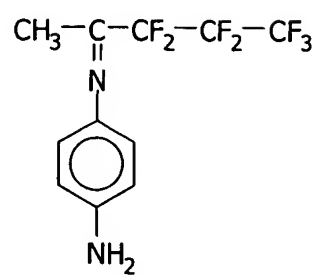
1 35. The method according to Claim 34, wherein high  $T_g$  materials are  
 2 prepared by selecting and reacting fluorinated monomers with nonfluorinated  
 3 monomers.

1 36. A functional optical material for use in an optical system comprising:



2  
 3  
 4 wherein  $x_1 = 50 - 80$  wt.%,  $x_2 = 10 - 15$  wt.%,  $x_3 = 1 - 5$  wt.%,  $x_4 = 5$   
 5  $- 20$  wt.%  
 6 and wherein one or more of said -F atoms may be substituted by an -H atom.

- 1 37. A compound comprising:



2

38. A compound comprising:

